AFRL-HE-BR-TR-1998-0072

UNITED STATES AIR FORCE RESEARCH LABORATORY

DESIGNING INSTRUCTION FOR DISTANCE LEARNING

Robert G. Main

College of Communication and Education
California State University
Chico, CA 95929-0504

HUMAN EFFECTIVENESS DIRECTORATE
MISSION CRITICAL SKILLS DIVISION
7909 Lindbergh Drive
Brooks AFB, Texas 78235-5352

May 1998

NOTICES

This report is published in the interest of scientific and technical information exchange and does not constitute approval or disapproval of its ideas or findings.

Using Government drawings, specifications, or other data included in this document for any purpose other than Government procurement does not in any way obligate the US Government. The fact that the Government formulated or supplied the drawings, specifications, or other data does not license the holder or any other person or corporation; or convey any rights or permission to manufacture, use, or sell any patented invention that may relate to them.

The Office of Public Affairs has reviewed this technical report, and it is releasable to the National Technical Information Service, where it will be available to the general public, including foreign nationals.

This technical report has been reviewed and is approved for publication.

HAL M. CLARK, Major, USAF
Contract Monitor

R. BRUCE GOULD, Ph.D.
Chief, Mission Critical Skills Division

If you change your address, wish to be removed for this mailing list, or your organization no longer employs the addressee, please notify AFRL/HEOP, 2509 Kennedy Circle, Building 125, Room 158, Brooks AFB TX 78235-5118. You may write or call the STINFO Office at DSN 240-3877, or Commercial (210) 536-3877. E-mail address is shirley.walker@platinum.brooks.af.mil.

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	May 98	Final June 96 - August 96

4. TITLE AND SUBTITLE

Designing Instruction For Distance Learning

5. FUNDING NUMBERS

PE- 62202F
PR- 1123
TA- A3
WU- 10

6. AUTHOR(S)

Robert G. Main

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

College of Communication
California State University
Chico, CA 95927

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

Air Force Research Laboratory
Human Effectiveness Directorate
Brooks Air Force Base, TX 78235-5118

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

AFRL-HE-BR-TR-1998-0072

11. SUPPLEMENTARY NOTES

Air Force Research Laboratory Technical Monitor: Terresa E. Jackson (210) 536-3908

12a. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release; distribution unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

The requirement to keep pace with the rapid advance of technology and the associated explosive growth of knowledge in every field, coupled with frequent employee turnover, has placed increased pressure on the training and education fields to meet the demand. Emerging communication technologies have enabled alternative methods for delivering training via distance learning that are being rapidly adopted by academia and industry. While distance learning has been demonstrated to be an effective and efficient tool for increased access it also requires greater emphasis on instructional design and instructor training to obtain satisfactory results. Based on a growing body of literature and actual field experience with alternative delivery methods, specific guidelines for designing and developing distance learning courses are recommended. The new communication technologies offer an exciting opportunity to educators and trainers for creating radical new learning environments that take optimal advantage of the new capabilities contained in the computer and communication technologies. In addition, a new model is proposed that integrates the behaviorist and constructivist approach to acquiring knowledge.

14. SUBJECT TERMS	15. NUMBER OF PAGES
Distance Learning, Instructional Design, Distance Learning Guidelines, Course Development, Learning Model	35
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	UL

TABLE OF CONTENTS

FIGURE

PREFACE

This technical paper addresses the many design and development issues that need to be taken into consideration early in the planning stage when implementing distance learning. In order for distance learning courses to be successful they require significantly more planning and organization than traditional classroom courses.

This research was conducted under the United States Air Force Summer Faculty/Graduate Student Research Program. The research was sponsored by the Air Force Office of Scientific Research/AFMC, United States Air Force.

SUMMARY

The requirement to keep pace with the rapid advance of technology and the associated explosive growth of knowledge in every field, coupled with frequent employee turnover, has placed increased pressure on the training and education fields to meet the demand. Emerging communication technologies have enabled alternative methods for delivering training via distance learning that are being rapidly adopted by academia and industry. While distance learning has been demonstrated to be an effective and efficient tool for increased access it also requires greater emphasis on instructional design and instructor training to obtain satisfactory results.

Based on a growing body of literature and actual field experience with alternative delivery methods, specific guidelines for designing and developing distance learning courses are recommended. The new communication technologies offer an exciting opportunity to educators and trainers for creating radical new learning environments that take optimal advantage of the new capabilities contained in the computer and communication technologies. In addition, a new model is proposed that integrates the behaviorist and constructivist approach to acquiring knowledge.

DESIGNING INSTRUCTION FOR DISTANCE LEARNING

I. INTRODUCTION

Traditionally the effectiveness of distance learning instruction has been measured against the learning outcomes of a "regular" class using a common test instrument. Similarly, the cost effectiveness of distance learning technology is to compare it with the cost of the traditional classroom programs. A study by North Central Regional Educational Laboratory concluded, "Effectiveness is not a function of the technology, but rather the learning environment and the capability to do things one could not do otherwise. Technology in support of outmoded educational practices is counterproductive. Technology works because it empowers new solutions (Jones, Valdez, Nowalkowski and Rasmussen, 1995, p.6)." This study explores new models and methods for use by instructional designers and developers for exploiting the technology of distance learning for creating more effective instruction.

The rapid rise of digital telecommunications and the transformation of media from analog to digital formats have opened the door to instructional delivery possibilities that have never been seen before. Archives of lunar travel and space exploration, video and audio files of news and information around the world, and entire library reference services are being made accessible to learners of all ages through the Internet. These resources and technologies are no longer restricted to an elite community and they are changing the nature of education and training forever as a result (Capell, 1995). Organizations are beginning to change their question from "Should we be doing distance learning?" to "When are we going to begin distance learning?" The very nature of learning is changing with the new opportunities provided. The demand will be on greater access, improved interfaces and more interesting and stimulating presentations by an expanded learner base. Satellite presentation at present is the dominant delivery technology and will likely remain competitive for a considerable period of time. The change to network-based multimedia delivery systems is inevitable, however, as the initial capitalization costs for fiber optics and other wide band installations are amortized through user volume.

II. DEFINING DISTANCE LEARNING

Distance learning terms are defined by a national task force of distance learning scholars chaired by the American Council on Education as follows:"

a) *Distance learning* is a system and a process that connects learners with distributed learning resources. While distance learning takes a wide variety of forms, all distance learning is characterized by:

1) Separation of place and/or time between instructor and learner, between learners and/or between learners and learning resources;

2) Interaction between the learner and the instructor, among learners; and/or

3) between learners and learning resources conducted through one or more media; use of electronic media is not necessarily required.

b) The *learner* is an individual or group that seeks a learning experience offered by a provider.

c) The *provider* is the organization that creates and facilitates the learning opportunity. The provider approves and monitors the quality of the learning experience. Providers include schools, colleges and universities, businesses, professional organizations, labor unions, government agencies, libraries, and other public organizations (Guiding Principles for Distance Learning in a Learning Society, 1996.)

This definition would include correspondence courses by mail as well as instruction via the Internet, by television or radio broadcast, individualized computer programs, video and audio tape, CD-ROM, and full motion interactive audio/video and data in real time. Each form represents particular challenges and opportunities to the instructional designer. For illustration, this paper focuses on real time interactive audio/video systems. The design principles, however, should apply to all forms of distance learning.

III. INSTRUCTIONAL DESIGN

The Delivery System Is the First Consideration:

Most Instructional Design models do not consider delivery modes until the Analysis Phase

is complete. Usually they are selected after the needs assessment has been completed, the learning objectives developed with their criteria for measurement, the learning strategy selected and instructional activities sequenced. The assumption is that the learning will occur in a traditional classroom. This is entirely appropriate as 95% of formal education and training is still conducted with students assembled in a room with an instructor delivering or at least controlling the instruction in a real time, face-to-face interaction. As communication technology capabilities improve and education and training requirements expand, the need for alternative delivery methods is increasing.

Instructional strategies and activities for distance learning involve all the components of instructional design with the added complexity of distance delivery (Wagner, 1990). In his *Report on Distance Learning Technologies,* Capell (1995) states:

> The landscape of educational decision making has changed with advances in instructional technology. If the ISD model (or other variation) is assumed as the basis for course development, then not only can we say that the decisions themselves have changed, but the timing as to when the decisions are made has also changed in reference to this model. This means that it is now appropriate to ask about the use of technology at the same time that instructional goals are considered as opposed to waiting until we reach *develop instructional strategy* or *develop and select instructional materials.* This is a big change over past practice, in which the use of instructional technology would have been considered only well after the objectives of the course were determined (p.50).

Effective Learning:

There is a dramatic shift occurring among educators in the definition of learning from the traditional transfer of knowledge and skills model which implies an expert presenting information to an engaged learning model with all the implications for responsibility, control and interactions. While this phenomenon is not unique to distance learning, the application of the fundamental principles require greater attention when the instructor and students are not face to face in a classroom. The variables for selecting the delivery strategies and designing the learning activities

for engaged learning are (Jones, et al, 1995, p.7):

a) learners engage in authentic and multidisciplinary tasks

b) assessments are based on performance of real tasks

c) learners participate in interactive modes of instruction

d) learners work collaboratively

e) learners are grouped heterogeneously

f) the instructor is a facilitator in learning

g) learning is by exploration

Analysis of the Delivery System:

The first step in designing instruction for distance learning is the analysis of the delivery system. The assumption is that the instructional designer will not have the luxury of specifying the delivery system, but will have to work with the capabilities that exist. It is also axiomatic that the lesson must be developed for delivery over the least sophisticated technology available to its intended users (Bradley and Peacock,1996). If some distance learning users are restricted to transmission rate of 19.2 kbs, for example, that becomes the limiting factor in the instructional delivery. This is the weakest link rule.

Selecting the Instructional Strategies:

There are four overall considerations in creating an engaged learning environment in a distance learning course:

(a) The learners must assume greater responsibility for their own learning. They must exert initiative and greater self-regulation than students in a traditional classroom setting.

(b) They must be more aware of their knowledge and skill acquisition. Self assessment and knowing *how* to learn is as important as *what* they learn. Constructing effective mental models of the subject domain is critical for knowledge transfer and connection.

(c) The learners must be motivated to learn. They derive excitement and pleasure from learning that energizes them to take additional steps to refine their knowledge and problem solving skills.

(d) Teamwork is emphasized. The learning is collaborative to instill the value of other's

viewpoints and the ability to work with them skillfully.

Designing Learning Activities:

Learning activities should be relevant, challenging and authentic. The knowledge and skills must be explicit to the learner's self-interest--not the organization, although that benefit should be implicit. The tasks assigned must be sufficiently difficult to be mentally or physically interesting, but not to the point of sustained frustration. The learning activities are authentic when they replicate behaviors beyond the classroom setting in real-life tasks. The activities should be in a context that links part tasks to complex tasks. In other words, students should learn by doing whenever possible.

Instructor Role:

Activities should be learner centered instead of instructor centered. In a distance learning environment where interruptions in communications may occur unexpectedly and frequently it makes sense to move the locus of instructional activity to the student as much as possible. It is also pedagogically sound to make the instructor more a facilitator or guide than the presenter of the lesson content. A well designed distance learning lesson can provide a rich learning environment by creating opportunities for students to work collaboratively, to solve problems, conduct research, do authentic tasks and simulations, and share knowledge and responsibility. This often requires a different set of skills for the instructor as mediator, model and coach. Instructors must constantly monitor and adjust to student needs for information, resources and problem solving strategies. This can be a difficult transition for instructors accustomed to being the center of knowledge and attention.

Learning Assessment:

Learning assessments should allow students to demonstrate their knowledge and skills in authentic tasks or projects. Performance based assessments should involve planning and execution as well as self and peer evaluations of products, presentations and debriefings. In team projects, involving the group in the development of the assessment measures and procedures is itself a challenging and meaningful learning activity. The ideal situation is where the instructional

activities and the assessment are seamless and transparent to the learners as they move from one to the other. It is critical that standards are well defined and equitable.

Grouping Learners:

Collaborative learning activities often involve small groups or teams of two or more students within proximity or at different learning sites. Although each learner's role and tasks may be different, all members collaborate to accomplish a joint objective or product. Assigning students in proximity with each other is desirable when all other factors are equal. Students can work together off-line with the rich interaction of face to face interaction and without the telecommunication costs. There may be other factors, however, where it is desirable or necessary to create groups with members from geographically separated sites. It may be important, for example, that students have experience in distance collaboration using the telecommunication technology. Exercising the technology may be a learning objective for the class.

A technique used at California State University, Chico, for a course taught over the Internet, involved the pairing of students with varying prior experience. A required class for Communication majors, the students beginning knowledge ranged from extensive technical skills to never having used a computer. A skills assessment administered during the first class session provided a rank order of class members for skill level. The students were then assigned as two person teams with the number one ranked student and the lowest ranked student in one team, the second ranked student and the next to lowest ranked student in another team. The process was repeated until all students had been paired. Students were provided an extensive syllabus for the course explaining the learning objectives for the class and a detailed description of how the class would be taught using the Internet. The purpose of the teams was explained and that learners of varying abilities had been purposely assigned to provide peer tutoring for less experienced students.

The Team Approach:

The instructional design/development team should be assembled with the customary instructional designer and one or more subject matter experts supported by the necessary media

production expertise to create the lesson materials. In addition, the team should have the services of a telecommunication technician either as a member or as a readily available consultant.

It would be ideal, of course, if the instructional designer could analyze the instructional needs and appropriate strategies and then design the delivery system that best accommodates the learning events developed to achieve the desired learning outcomes. Practically speaking, the instructional designer/developer is given the task to produce a course to be presented over an existing system. It is imperative, therefore, that the designer have explicit knowledge of the capabilities and limitations of the system and how it operates. If possible, the designer should have taught or taken a class using the distance learning system.

Instructor Involvement in the Instructional Design:

It is a good strategy to involve the instructor in the design process for the distance learning class. Few distance learning classes are "new" courses. In an examination of 81 distance learning courses offered over a four-month period at California State University, Chico, Dillon (1996) found only five had not been offered previously as traditional classroom presentations. Furthermore, the five that had not been previously taught were specially tailored workshops designed for one time scheduling to meet a particular need for adult education. Although this is a university where curriculum changes are not as common as industry training programs, the development of a totally new class for distance learning delivery is most likely the exception for corporate training needs as well.

It is only logical that the best candidate to teach the distance learning class is the instructor who has been teaching it in the traditional classroom. The instructor serves not only as a subject matter expert, but also as the expert on pedagogy for the class. His or her experience is invaluable in the restructuring of the learning strategies and activities to fit the limitations and capabilities of the distance learning delivery system

Convert Easiest Courses First:

If the situation permits, the introduction of distance learning classes should start with

those courses most easily converted. This usually means those where the mode of instruction is primarily lecture based. The planning team can go through the course listings currently being offered and rate the classes as to the level of effort required for conversion (e.g. minimal, moderate, extensive). Not only does this allow for an easier transition for the design and development team, it also provides a lower slope to the instructor's learning curve for distance learning presentations. An obvious bonus benefit for including the instructor in the design and development process, is the knowledge gained of the delivery system. By beginning simply, the confidence of the instructor in the system is reinforced by success. The design and development team will also learn from their experiences. With the simpler conversions as a starting point, the complexity of the curriculum development is incremental so that the level of effort for each course preparation remains relatively constant.

Formative Evaluation:

Formative evaluation is critical for all instructional design. Braden (1996) has incorporated it as an explicit function of each step in his adaptation of the Dick and Carey ISD model. Main (1993) shows validation and feedback as an integrated activity for each phase of his motivation integrated ISD model. The importance of validating each activity in the design process is elevated in distance learning development. In traditional classroom instruction, the rich and immediate feedback from the students permits the instructor to make changes in the delivery on the fly. Good instructors are continuously monitoring their classrooms for visual and audio cues that indicate students are attentive and actively engaged in the learning process. Corrections can be made individually and collectively to modify the planned activity to insure student comprehension and involvement. This is not possible in distance learning environments. Even in the most sophisticated virtual classroom, the technology degrades the quality of interaction. In most distant learning systems, the students cannot be seen by the instructor or can only be seen when they wish to speak. The small screen and low fidelity of wide area classroom views makes it difficult to distinguish individuals let alone their facial expressions. Pilot testing of every aspect of the lesson is essential. Not only is feedback limited in distance learning environments, but the flexibility of the instructor to change delivery is restricted by the technology and time pressures. It is much more difficult for students to hang around and ask questions of the instructor after class

unless this provision has been built into the lesson during its design so that network time is available

Learner Motivation:

Main, Robinson and Scott (1992) found technology required greater attention to learner motivation in the design of instruction. In traditional classroom presentation, the instructor is largely responsible for attracting and maintaining learner attention. Personal anecdotes or examples from the instructor's repertoire of experience can be inserted to establish relevance for the learner of the knowledge and skills being taught. The level of difficulty of the lesson can be adjusted on the fly to bolster the learner's confidence. Encouragement and feedback regarding learner performance is immediate and contextually rich. Good instructors do these things automatically. They are in continuous rapport with the performance and mood of the class members.

Where interaction is intuitive in the traditional classroom, it must be carefully planned for in distance learning environments. Bradley and Peacock (1996) express concern that distance education may not allow for that vital human contact with instructors, resource people and other students that is such an essential part of a good education. The challenge for the instructional designer is whether distance learning will be just a poor substitute for more personal (and arguably more effective and desirable) traditional means of teaching, or whether it can be used for a qualitatively different type of instruction.

A great deal has been written of the ability of computer delivered instruction to individualize instruction to the learner's needs. However, the most advanced artificial intelligence technology cannot begin to match the ability of even a mediocre instructor to respond to the dynamics of a classroom. It is imperative, therefore, that when instruction is to be mediated by technology, the greatest attention is paid to designing learner motivation into the presentation.

IV. INTERACTION IN DISTANCE LEARNING

Classroom Interaction:

The successful expansion of distance learning as an alternative to the traditional classroom is dependent upon the instructional design to approximate the richness of the interaction that occurs face-to-face (Main & Riise, 1995). There are six factors which should be considered in designing distance learning interactions. They are: 1) The amount (frequency and length of dialog; 2) Type (instructor-student, student-student, and student-course content); 3) Timeliness (a continuum ranging from full duplex conversation to asynchronous exchanges with days of delay); 4) the Method of interaction (refers to the medium and channel used from voice to text to non-verbal gestures); 5) Spontaneity (refers to whether the transactions are preplanned or ad hoc exchanges triggered during the presentation); and 6) Quality of the interaction (intensity or emotional involvement, relevance, depth, formality, and opportunity).

Interaction always occurs within a context. There are numerous factors that may be affected by, or have an effect on, interaction in distance learning. These factors can generally be classified as those concerned with the course and those concerned with its delivery, i.e., the communication technology. Course or curriculum variables include the subject matter, student characteristics, instructional strategies and activities, media used, and instructor attributes. Variables associated with the delivery of the instruction are concerned with the transmission capabilities of the network (bandwidth and data rate) and hardware and software configurations of the origination and distance learning sites. Class size is an overarching variable in instructional interactions. As the size of the class increases, the chance of interacting with the instructor dwindles no matter how sophisticated the communication technology or elegant the instructional design.

Distance learning may depend even more on instructor charisma and style than the traditional classroom which means instructor characteristics are important in their effect on interaction. There is a large body of literature available on instructional process, but despite the scrutiny of what goes on in the classroom, teaching remains very much an art form. A study by Fulford and Zhang (1993) suggests the perception of overall interaction is a greater predictor of student satisfaction than actual personal interaction. In their study of a class of 123 students in five locations the perception of overall interaction (self-report) had a strong correlation with

learner satisfaction despite the number of personal interactions. This "vicarious" interaction effect should not be too surprising. The appeal of game shows and talk shows is largely the interaction between host and guests or contestants and their success is dependent on the artistry of the host in generalizing audience identification with him or herself and the topic.

While classroom interaction is almost universally considered an enrichment to the learning process, there is some evidence that it is not a critical component for learning. Studies by the Navy of video televised training (VTT) instruction found a significant reduction in interaction in VTT classes when compared with traditional classroom presentations. However, learning outcomes measured by the same multiple choice exam were identical for the groups (Wetzel, Radtke and Stern, 1993). This is not unusual in the literature. Study after study indicates student achievement in distance learning classes is equivalent or superior to traditional classroom student achievement (Salomon & Clark, 1977). In a meta analysis of media use in instruction, Simpson, Pugh and Parchman (1991) found, "Achievement is similar to conventional education with interactive television or video teletraining, and with correspondence telecourses" (p 153). Most distance learning studies are flawed, however, in their inability to control contaminant variables through random assignment to treatment and control groups or the use of matched pairs. They are generally case studies conducted in the field with the possibility of many differences in demographics between traditional classroom students and those taking the instruction at a distant location. At the very least, the distant learner by definition is being offered an opportunity for learning that might not otherwise be available without considerably greater effort and expense on the part of the learner. This tends to create a student who is more appreciative of the opportunity for the learning experience and consequently more dedicated. Lacking solid contrary evidence, it is only commonsensical to maximize interaction opportunities in the lesson design.

Learner Participation:

There is obviously an overlap in the concepts of classroom participation and classroom interaction as discussed above. For purposes of distinction, participation is defined as learner involvement in the instructional process. Participation is a more generic term that subsumes classroom interaction. It can be broadly categorized into classroom interactions (student-teacher,

student-student and teacher-student), group interactions, (projects, problem solving, team drills), interactions with learning materials and resources (research reports, reading assignments, homework activities), intellectual interactions (critical thinking and higher order cognitive skills such as analysis, synthesis, evaluation), and emotional involvement (attitude, attachment, motivation). Emotional involvement is more properly addressed as a function of mode and method of presentation.

The criticism of most distance learning systems in the past has been the imbalance between the amount of time spent by experts presenting information and the arrangements made for the learner to interact with the content, with the instructor and with other learners. This criticism is also valid for classroom presentations where an instructor (expert) lectures to the students. This large lecture model is popular with instructors (after all, they are in the position of authority and control) and administrators because of its low cost per unit. It persists despite the mounting body of evidence that learner centered strategies are more effective. But students do learn. It is superior to a textbook and to recorded lecturers in that there is some spontaneity and ability to adjust to student feedback. It is used widely in "educational television" programming where courses are presented by television station broadcast or satellite transmissions to large audience groups. The participation is analogous to talk radio or television where the limited audience interactions are presumed to be representative of the wider audience.

In the lecture mode, student participation with the content can be accomplished with assignments performed outside the class period. These may be reading assignments, research papers, or problems to solve. Students may be required to watch a film or video or listen to an audio tape. Group activities and collaborative learning projects may be assigned that will require students to interact with each other outside the regular class period and report or demonstrate their work to the class at large.

Asynchronous Interactions:

There are a number of distance learning systems in which synchronous interactions are not feasible. The oldest, of course, are the correspondence courses that have been offered for more

than a century and are still attracting students. They are primarily print-based although there are audio and video tape versions as well. The Public Broadcasting Service (PBS) member stations offer a number of telecourses, often in conjunction with local colleges and universities, that are received by students on their television receivers at home or office. If college credits are to be awarded, registration, graded assignments and tests are usually administered by mail or at scheduled meeting times in a local classroom. Professors receive a stipend for providing advising, grading and exam proctoring.

The latest in asynchronous instructional interactions are the online programs springing up across the nation using the Internet, commercial on-line services or corporate data networks. The delivery of instruction asynchronously changes the nature of the teaching function from lecturing to coaching (Mason and Kaye, 1989). The challenge of communicating without visual or audio cues, coupled with the lack of immediate feedback can lead to anxiety or misinterpretation of the intended message which makes faculty feedback particularly important. Instructors need special training in the nuances of on-line communication. Consider the reliance placed upon body language and facial expressions in traditional classroom instruction. The instructor may respond to student comments with a smile or a nod and this non-verbal communication is meaningful and satisfactory to both parties. Failure to respond to questions on-line can be viewed as rejection by the communicator (Hedegaard, 1996). The use of sarcasm, humor and irony must be carefully composed or avoided. They can be easily misinterpreted when delivered in writing because this is a very literal environment.

There is a positive side to the online computer-mediated instruction. According to Mason and Kaye (in Harasim, 1990), the lack of visual cues creates a unique democratic atmosphere. On-line class groups can work together, dialog, debate, and converse indefinitely without being prejudiced by race, gender, appearance or even personal charisma. Individual contributions are valued on their merit and content of the message is the primary focus. This is an ideal situation for developing critical thinking tools and creative problem solving techniques. Of course descriptive identifications of participants can be provided when necessary.

V. LEARNER AUTONOMY

Learner autonomy is participation by the learner in the determination of their learning outcomes. In various forms it is referred to as constructivism, student centered learning, locus of control, et al. It begs the larger question, "Who knows best what behaviors the learner must master?" While there is general agreement that subject matter experts and instructional designers/developers are best prepared to package and deliver the instruction, there is less agreement that the learner is in the best position to determine what knowledge and skills they need to acquire (or even when they know what is best for them that given an opportunity to choose they will select what is best).

It is certainly true that self selection will provide a more motivated learner (a powerful argument for just-in-time training). It seems less self evident that learners are in the best position to determine their own needs, or, in the case of corporate training, whether their needs meet the expectations and needs of the organization. Tasks and employee performance levels seem best determined by experienced practitioners and managers. Scholars in the field may have an even broader view of knowledge and skills needed beyond the narrow context and situation of a specific job in a particular company.

Even if the performance desired could be explained in detail under the conditions of performance and the level of proficiency required, it is still possible that learners would lack the self-assessment ability to make correct curricular decisions. Students are notoriously inaccurate in evaluating their own level of knowledge and skill levels. A study by Nicelescu-Maier (1995) found student expectations of their grade varied on average one full grade level from the grade awarded by the professor. The range was as much as three grade levels above the actual grade to two grade levels below. Furthermore, it is human nature to wish to increase our knowledge in those subject areas we like (and are often most proficient) and avoid those subjects we dislike. Main (1986) found the most common reasons listed by students in a beginning communication class as to why they had chosen a communication major was that no math was required.

VI. BEHAVIORIST VERSUS CONSTRUCTIVIST COMPROMISE

Perhaps some accommodation can be reached between central design of curriculum and design to student need if we accept the optimal learning curve model for behavioral v. constructivist design methods. A learning curve is constructed of the knowledge, skill or affect to be achieved. An optimal point along the curve is selected where it is agreed that this is the minimum proficiency level necessary for job entry level skills, knowledge and attitude (see Figure 1). This is usually the point where the person can be productive in the job assignment without endangering him or herself or the organization. Further refinements, expansion and enhancements of proficiency are accomplished at the work site, on the job or through individual activities outside formal class work. This includes work experience, on-the-job training, mentoring and other formal and informal arrangements for instruction.

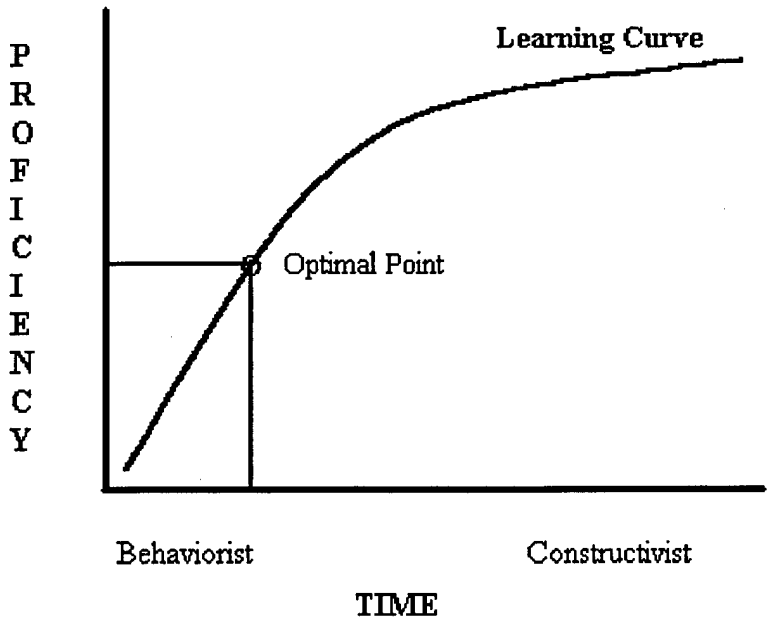

Figure 1. An Integrated Behaviorist/Constructivist Model

Distance learning technology offers a new tool for just-in-time, in place training. Advanced classes and modules can be offered via a PC-based learning station in a classroom at the work site or on an office desk where workers can select instructional modules or courses that meet their particular learning needs. The model offers a structured approach for generic or basic skills (behaviorist approach) with the opportunity for acquiring additional knowledge and skills as

needed by the individual (constructivism). The system could serve multiple functions in some organizations providing technical consulting service for operation and maintenance problems, technical library resources for research needs as well as training and education delivery. Indeed these functions overlap to great degree and are characteristic of the learning organization.

In this model, constructivism may be a powerful model for empowering and motivating the learner to continue his/her progress along the learning curve. In other words, the basic skill and their level of performance are highly structured behaviors where some sort of consensual standard has been established. After this formal, structured learning process is completed with entry level competencies certified, the learner is supported in continuing the learning process. It is in this stage where learning curve may be shaped by the learner to reflect individual needs and motivations. For a more detailed discussion of constructivism in instructional design see Jonassen (1990, 1991a, 199lb), Merrill and Jones (1990) and Merrill (1991).

VII. DISTANCE LEARNING DEVELOPMENT ISSUES

There are a number of factors that need to be considered in the design and development of distance learning classes. The following list is by no means exhaustive. Each situation is unique and may include a varying number of the factors listed as well as others not identified. This provides a starting point for the analysis required.

Scheduled versus On-demand Instruction:

In traditional standup training programs, classes are scheduled and students select or are selected for attendance according to a catalog produced by the organization providing the training. Administratively, it is necessary to accommodate facilities and resources to organizational training needs in some efficient and ordered manner. As a result, the instructional design must include all the knowledge and skills required for the trainee to be certified for particular job tasks to be performed over the next several months or years. These are usually entry level performance requirements and graduates are expected to hone their skills through on-the-job training, apprenticeship or mentoring. Much of the knowledge presented in the course content may not be encountered routinely by the trainee because it is infrequently required or

because it is performed only by advanced practitioners. It is included in the curriculum because it is impractical to bring students back to the classroom for instruction just as it is needed. Distance learning systems, particularly desktop systems, offer an opportunity to provide just-in-time training and refresher instruction on demand. The Navy has found, for example, that even regular distance learning courses can be used by commands to provide refresher training for specific tasks. Diesel mechanics on duty with the fleet in one instance will be able to register for only the portion of a course they need for refreshing their knowledge on Diesel Operation and Maintenance that is being telecast from the Service School Command, Great Lakes Naval Training Center (NTC) (Larson, 1996).

In another case, crewmen on board a Navy Frigate, in San Diego were receiving distance learning instruction on gas turbine engine maintenance via a desktop two-way video, audio and data link from Service School Command, Great Lakes NTC, via Damneck, Virginia when an instructor noticed from their body language cues that they were unfamiliar with an oscilloscope test instrument needed for a maintenance procedure. A departure from the course curriculum was made for a class on the test instrument which solved a specific maintenance problem with the engines of their ship (USS Rentz Ship to shore, 1996). This example also illustrates the issue of two-way video versus one-way video with two-way audio and of real-time synchronous versus asynchronous interactions.

Two-Way versus One-Way Video:

The traditional classroom offers face-to-face interaction within a full contextual frame. Both instructor and students see and hear the content along with gestures, eye-contact and the carriage of both students and instructor. The subtlety of cues is often so automated we are unaware of them or their effects on a conscious level, yet the dialog is adjusted to accommodate them. It is no accident that most comedy programs on television are produced before a live audience. The actors and crew need the feedback for their timing and inflection. The face-to-face arrangement provides a naturalness to the interaction that is not achieved through verbal range alone. Also, it is the familiar method of receiving instruction. Although there is little evidence in the literature that there is sufficient increase in learning efficacy to support the added costs of

two-way video, most of the studies are methodologically flawed. No studies are found where the independent variable of two-way versus one-way video has been satisfactorily isolated from contaminant variables (Wetzel, et al, 1993). Certainly for some types of subject content involving skills training, it is intuitively evident that the ability to see student performance would be a powerful addition to the instructor's ability to allow practice and critique performance.

Evaluation and Assessment--Knowledge versus Skills:

One of the reasons distance learning has been so widely and successfully used by colleges is that education courses are designed primarily by content analysis while military and industry training is more often based on task analysis. Whether content or task analyses are used does not change very much what is taught but it has great impact on how the instruction is presented. Content analyses results in a cognitive domain content with performance measured, by and large, by recall of facts, concepts and constructs. Task analysis results in instruction that is activity oriented with achievements measured by task performance usually demonstrating some level of a skills mastery. Paper and pencil tests provide weak performance validity for skills measurement, but are quite adequate for knowledge acquisition. The distance learning designer/developer must select criterion reference test items that can be accommodated by the distance learning system.

Performance measurement, or testing, is perhaps one of the greatest weaknesses in education. In a study of test construction by college faculty, Main (1990) found that on average 85% of course grades in a college communication curriculum were knowledge based and measured by objective or short answer exams. Even in courses where students were required to use equipment and generate a product (audio production, for example), 60% of the course grade was based on objective tests rather than the authentic assessment measures. And, while objective exams can be constructed that test critical thinking and cognitive skills, the vast majority of items are simply recall of course content. Professors unanimously indicated they modified their exams to reflect only material covered during class periods.

Adult vocational training is much more dependent on task performance for learning assessment. When adapted to distance learning scenarios, accommodations must be made to

insure the validity of skill performance measurement is maintained. If two-way video is available on the system, a "show me" exercise can be designed. When this is impossible because of time or system limitations, qualified evaluators at the distant site location can be employed to administer or monitor performance tests. Simulations (both computer-based and paper-pencil) can be created with problems and scenarios that will assess both procedural and problem solving skills. If qualified examiners cannot be assured at the learning site, the course designers must create other methods for recording student performance for evaluation. Students may be required to perform a writing task that demonstrates a skill and knowledge ability, proctors may video tape a physical performance (modern dance, for example), and portfolio reviews may be used where a collection of student products are assessed for competency level. These can be transmitted by digital file (e.g. e-mail, Internet, or the distance learning systems data links), by fax or by snail mail.

Test Administration:

Two factors that contribute to student satisfaction are the opportunity to apply knowledge learned and the prompt return of assignments and tests. In a distance learning environment, extra attention must be paid to the evaluation of learning outcomes. Because students are usually isolated and have limited opportunities for comparing their progress with others in the class, the frequency of evaluations may need to be increased and feedback on performance provided promptly. Performance ranges and test means should be available for students. Even when the training is competency based with no grades assigned, students want to know their relative performance with others in the course.

In a study by Cole, Coats and Lentell (1986), students in distance learning classes expect:

a) fair and objective grading;

b) to have their work treated with respect;

c) an explanation and justification for the grade awarded;

d)- a clear indication of how to improve their performance;

e) encouragement and reassurance about their ability and progress;

f) constructive criticism and advice;

g) an opportunity to respond; and

h) a timely response (before the next assignment is due).

Test security presents a challenge in some situations. Proctors may be designated to administer the exam to students or on-line exams can be administered with students responding through their computer link in much the same fashion they would complete a quiz in the traditional classroom. Open book exams with open-ended and essay responses provide a reliable methods of evaluation.

Learning Activities--Individual versus Collaborative:

Most educational learning activities are individual. However, in seminars, workshops and particularly in skills training courses, collaborative efforts are often desired. The ability of the distance learning system must be carefully examined to determine the capabilities that exist for group interactions. It may be possible to provide telecommunication links between students from multi-point sites which would provide the same interactions between students that exists between student and instructor. This capability requires advanced switching hardware and software that is just beginning to become commercially available. The Internet provides the most universally available capability for students to work together. Text, visuals and even audio can be exchanged either asynchronously in e-mail accounts, bulletin boards, and files, or in real-time exchanges in chat rooms established for the class or for student groups. If distance learning sites are in actuality satellite classrooms, students can do collaborative projects within their proximate group and report their results to the full class. The activities can be conducted during scheduled class periods or the work conducted during non-class time.

A course at California State University, Chico is being taught over the Internet exclusively with all assignments posted to the bulletin board and discussions held in chat rooms. Content is accessed from a website and research is conducted using data bases accessed from the Internet using a commercial search engine. Office hours are held on a scheduled basis by the instructor and by appointment. Both public and private interactions are possible. Student projects, individual assignments, even exams are distributed and turned in via the Internet. Administrative

functions such as scheduling, registration adds and drops have been attempted but are not entirely successful to date. Payment of fees and access to other student services are not provided over the telecommunication network. Because of the widely divergent skills of students entering the class, a diagnostic pretest is administered to each student at the beginning of the semester. Students are ranked by score and paired as teams throughout the course. The top scoring student is paired with the lowest scoring student and the process repeated until all students are assigned into two person teams. The objective is to provide inexperienced students with a tutor teammate who can provide one-to-one assistance in learning the technology. Grades are team-based so that experienced students have an incentive to make their colleague proficient.

The University of Phoenix has eight years of experience in computer-mediated online education. They have found that when faculty take the time to orient their distance education students on self-direction and peer reliance, they can effectively diminish the teaching load as students themselves take more responsibility for meeting their learning goals (Hedegaard, 1996).

Contingency Planning:

Although distance learning technologies are becoming increasingly reliable, they are subject to partial or total interruption. Strategies must be planned in advance and preparations made for contingency delivery of instruction. For partial system failure where one or two or even more students lose their communication link, a recording of the presentation screen and audio of the class can be made as a routine procedure and copies sent later. This is a relatively inexpensive and simple solution for keeping students on track, but care should be exercised that students do not abuse it to miss scheduled classes for personal convenience.

Most subject matter is hierarchical in nature, but there are components to every curriculum that do not require teaching in sequence. The instructional designer (with the instructor) should go through the lessons carefully designating learning activities that are dependent, those that are supportive and those that are independent of prerequisites. For example, teaching multiplication is dependent upon first knowing addition. On the other hand, computing the area of a rectangle is not a prerequisite for computing the area within a triangle.

But, knowing how to do one helps in learning the other, i.e., some of the knowledge is transferable. It doesn't matter which concept is taught first, but having learned one skill, it will take less time to teach the second. Learning to compute the area of a circle is, however, independent of computation for areas of triangles or rectangles. It doesn't matter which is taught first. By identifying these "independent" learning objectives, the instructional designer can prepare learning modules of these lessons in advance and have them packaged with other materials relevant to the students and sent to learners when they register along with instructions of how to proceed if a class is canceled.

Content may be prepositioned at the distant learning site(s) in a variety of forms and media. Print may be in hard copy, a floppy disc, CD-ROM or a data file on the hard drive or available on a server. Audio may be stored on cassette, CD-ROM or as a data file on a server. The same holds true for video segments. They can be prepositioned as video cassettes, CD-ROM's or, in compressed form, as data files on a server. Computer Based Instruction (CBI) can be available at the distant learning site stored on floppy disc, CD-ROM, or as a data file on the hard drive or on a server. Programs can be interactive multimedia modules, simulations or reference files. The instructional activities can be as varied as reading assignments, research and writing projects or interactive learning modules complete with competency based tests. Learning activities conducted outside the regular class period are often where higher order cognitive skills are required--analysis, synthesis and evaluation-as well as remedial and/or drill and practice exercises that reinforce knowledge acquisition.

Perhaps most important of all, using a mixture of media, allows for differences in student learning styles. Some learners prefer the reflective thinking associated with print. Others may be motivated by the competitive nature of an interactive game-based module or the concreteness and realism of motion video. The more media alternatives provided, the more effective the distance learning environment is likely to be for a wider range of students (Moore and Kearsley, 1996).

There are, of course, no assurances distant learners will actually use the contingency lesson materials anymore than they will accomplish homework or other out-of-class learning

activities. To insure learners understand their responsibility for interrupted classes, the course syllabus or student learning guide should include instructions about the contingency lesson materials and how they are to be used. Test items, quizzes and graded assignments can be used to enforce student compliance if this is necessary.

Media Integration and Presentation Control:

In most distance learning environments a combination of media forms is used. The benefits from a mixed media environment are many. No single medium can effectively meet all the learning objectives across a full course or program, the differing learning styles of individual students, or the capabilities of the delivery technology. Multiple media provide interest and flexibility. There are a number of very helpful models available to assist the course developers in media selection. Bill Walsh (1996) has developed an excellent summary of them in a practical guide for distance learning designers (App. B, in press).

Of more interest in this study is how the media will be presented. More specifically, will media presentation be centrally launched from the instructor's site or will individual learners exercise presentation control. The traditional method, of course, is instructor control. The instructor prepares the class with the use of the media scheduled in the lesson plan. At the appropriate time the media are used and the instructor continues with the remaining learning activities. While this procedure is familiar and comfortable for the instructor, there are a number of reasons for changing to student control of media presentations. The most important is the level of complexity that is introduced for network distribution of media by the instructor. Some of the issues are: 1) control over learner workstations by a central server, 2) inability of one or more sites to receive the signal, 3) data storage requirements for multimedia, and 4) network data transmission requirements for full motion video of sufficient fidelity for full screen instruction (Main, Curtis and Presnell, 1996).

It may be preferable to position media at the distant learner's site where it will be used upon the appropriate cue from the instructor. Some of the benefits are:

a) It facilitates contingency planning when technology failures occur as previously

discussed.

b) It distributes knowledge throughout the system allowing greater independence for access by individual learners.

c) It allows for differences in learner experience, abilities and/or motivation in time on task. Some learners may need to review the materials because they lack background or interest to master the initial presentation. It is interesting that we would not think of requiring students to read text in unison because we know the reading speeds vary so greatly. Just because the presentation is fixed-pace does not necessarily mean it is processed at equal speed by all learners.

d) It permits a more heterogeneous mix of technology. This could be extremely important for public education or training consortia course offerings. By having the media in a variety of formats, students can request the format compatible with technology at their location.

e) It makes the learner a more engaged participant in the learning process by transferring responsibility from the instructor for accessing the learning content.

f) A wider range of media-based learning activities may be possible. For example an interactive CD-ROM-based simulation may not be suitable for centralized distribution. It may be restricted to one or two participants at a time. Just as reading assignments are not appropriate for in-class activities, some interactive multimedia programs may also be best used off-line.

Some of the potential disadvantages inherent in transferring control for media presentation to the learners include:

a) It requires a certain level of confidence and self-discipline to discharge this responsibility as well as the technical skill to operate the software and hardware involved.

b) Technical support may not be readily available if assistance is needed. Frustration thresholds can be very low when technology is involved. On the other hand, these skills and attributes may themselves be learning objectives which can be designed into the lessons as learning activities so that learners can be monitored and assistance provided as necessary.

c) The greatest advantage of local control (individualization of instruction) may, in some situations, be the greatest drawback. If standardization of the instructional *process* is important or if uniform progress is critical, then a lock-step central control is preferable.

VIII. SUMMARY

The overarching goal of instructional design for distance learning is that the technology be used to satisfy human needs and that human needs are not distorted to serve the technology instead. The technology should be used to enhance human to human contacts. If the instruction is intelligently designed with this in mind, the technology should tend to become transparent, not dominate the presentation (Bradley and Peacock, 1996).

Moore and Kearsley (1996) conducted an extensive review of distance learning literature and concluded distance learning requires:

a) A greater emphasis on instructional design

b) More instructor training than traditional classroom presentations.

c) More money for instructional materials development..

As communication technology capabilities improve and education and training requirements expand, the need for alternative delivery methods is increasing. The requirement to keep pace with the advanced technology and growth of knowledge in virtually every field, the changing nature of jobs and the increasing migration of workers between jobs and careers are some of the pressures for developing new ways to deliver instruction on demand. As the use of computer-based training and distance learning technology increases, there is need for new models or modification of old models for designing instruction. The purpose of this paper has been to surface some of the factors that should be considered in the process of designing instruction for distance learning.

REFERENCES

Braden, Roberts (1996), The Case for Linear Instructional Design and Development: A Commentary of Models, Challenges, and Myths, *Educational Technology,* March-April, 5-23.

Bradley, John and Kent A. Peacock (1996), Connecting to the Global Classroom: Distance Education in a University Setting, *ED Journal,* Vol.10, No.2.

Capell, Peter (1995), *Report on Distance Learning Technologies,* Software Engineering Institute, Carnegie Mellon Univ., Pittsburgh, PA.

Cole, S., M. Coats and H. Lentell (1986), Towards Good Teaching by Correspondence, *Open Learning,* Vol 1, No.1.

Dillon, Alicia, (1996), unpublished master's thesis, California State University, Chico, Chico, CA.

Fulford, Catherine P. and Shuquiang Zhang (1993), Perceptions of Interaction: The Critical Predictor in Distance Education. *The American Journal of Distance Education,* Vol.7, No.3.

Guiding Principles for Distance Learning in a Learning Society (1996), American Council on Education monograph, May, Washington, D.C.

Harasim, L. M. (1990), *Online Education: Perspectives on a New Environment,* Praeger, New York, NY.

Hedegaard, Terri (1996), Computer-Mediated Online Education: Lessons Learned by the University of Phoenix, *ED Journal,* Vol.10, No.2.

Jones, B. F., G. Valdez, J. Nowalkowski, and C. Rasmussen (1995), *Plugging in: Choosing and Using Technology,* Council for Educational Development and Research, North Central Regional Educational Laboratory, Washington, D.C.

Jonnason, D. H. (1990), Thinking Technology: Toward a Constructivist View of Instructional Design, *Educational Technology,* Vol.30, No.9, 32-34.

Jonnason, D. H. (1991a), Evaluating Contructivist Learning, *Educational Technology,* Vol.37, No.9, 28-33.

Jonnassen, D. H. (199lb), Objectivism versus Constructivism: Do We Need a New Philosophical Paradigm?, *Educational Technology Research and Development,* Vol.39, No.3, 5-14.

Larson, Orv (1996), Personal interview conducted at the Naval Personnel Research and

Development Center (NPRDC), San Diego, CA.

Main, Robert G., Terry Curtis, and Mick Presnell (1996), *Report of Findings Interactive Multimedia Distance Learning Experiment,* Darlene Hinds, ed., California State University, Chico, Chico, Ca.

Main, Robert G. and Eric Riise (1995), *A Study of Interaction in Distance Learning,* U.S. Air Force Technical Report, Armstrong Laboratory, Brooks Air Force Base, TX.

Main, Robert G. (1993), Integrating the Affective Domain in the Instructional Design Process, *Educational Technology,* Vol.33, No.12, 37-41.

Main, Robert G., Kate Robinson, and Joyce Scott (1992), *Integrating Motivation in the Instructional Design Model,* Air Force Office of Scientific Research Technical Report, Boiling Air Force Base, Washington, D.C.

Main, Robert G. (1990), *Instructional Design Practices Among Professors at a State University,* unpublished monograph, California State University, Chico, Chico, CA.

Main, Robert G. (1986), *Math Avoidance as a Factor in Career Choice Among Freshmen Communication Students,* unpublished monograph, California State University, Chico, Chico, CA.

Mason, R. and A. M. Kaye (1989), *Communication, Computers and Distance Education,* Pergamon Press, New York, NY.

Merrill, David, Z. Li, and M. K. Jones (1990), Limitations of First Generation Instructional Design, *Instructional Technology,* Vol.30, No.1, 7-12.

Merrill, David M. (1991), Constructivism and Instructional Design, *Educational Technology,* Vol. 31, No.5, 45-52.

Moore, Michael G. and Greg Kearsley (1996), *Distance Education: A Systems View,* Wadsworth Publishing Co., San Francisco, CA.

Nicelescu-Maier, Stefan (1995), *Grade Expectations as a factor in Student Evaluation of Faculty,* unpublished research paper, California State University, Chico, Chico, CA.

Salomon, G. and R. E. Clark (1977), Reexamining the Methodology of Research on Media and Technology in Education, *Review of Educational Research,* Vol.47, No.1, 99-120.

Simpson, Henry H., Lauren Pugh and Steven W. Parchman (1991), *Empirical Comparisons of Alternative Video Teletraining Technologies,* (NPRDC-TR-92-3), Navy Personnel Research and Development Center, San Diego, CA.

USS Rentz Ship to Shore (1996), video program of a training course from Great Lakes

Naval Training Center to a ship at sea, SEAADSA DSN 332, Naval Sea Systems Command, Great Lakes, IL.

Wagner, E., (1990), Instructional Design and Development: Contingence Management for Distance Education, in *Contemporary Issues in American Distance Education,* Michael Moore (Ed.), Pergamon Press, 298-311.

Walsh, William J., (1996), Instructional Design Handbook for Interactive Distance Learning, National Center for Manufacturing Sciences (NCMS), Ann Arbor, MI.

Wetzel, C. Douglas, Paul H. Radtke and Harvey W. Stern (1993), *Review of the Effectiveness of Video Media in Instruction,* (NPRDC-TR-934), Navy Personnel Research and Development Center, San Diego, CA.